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BEZOARS

BY

R. VAN TASSEL

SUMMARY

An historical survey is made of the chemical analyses of bezoars. More than two hundred specimens from twenty European institutes are examined at present with respect to their chemical and mineralogical composition. The reliability of old labels is discussed. The different kinds of bezoars are enumerated and the size of the stones considered. Twenty-four richly ornamented bezoars from treasuries and fine arts museums are described in detail.

I. INTRODUCTION

Bezoars are calculi (concretions) found in the body of animals, particularly ruminants. Unknown in Europe before the XIIth century, they were at first imported from the East and were held in great esteem in Europe, from the XVIth to the XIXth century, as a remedy for poison and many kinds of fevers and diseases. Owing to their supposed healing properties and their inherent value, many bezoars, especially the larger ones, were richly ornamented with noble metals and precious stones. They found their way into many Rarities Collections and Treasuries and later into history and art museums. At the present time, bezoars are still priced as a medicine in some countries, as Iran, Turkey, Indonesia, etc. Man-made products came into the market as a substitution for the genuine bezoar and records are even known of sentences punishing fraudulent sale (A. HALLEMA 1935, H. WAGENAAR 1939).

In a broader sense, the term has been used for calculi from men and for mineral concretions. Even to-day it is still used for indicating foreign objects agglomerated in the human body (tricho- and phytobezoars, shellac bezoars, bolus and bismuth carbonate concretions, etc.).

Literature on bezoars is not so rare as one would expect at an early

stage of examination, but references are scattered over a wide range of periodicals and books, in many cases not easy to find. An extensive bibliography, nevertheless still incomplete, with more than 200 entries, has been published in 1970 (R. VAN TASSEL). In this journal, a paper by H. FÜHNER (1901) has already been devoted to the subject, attention being paid in particular to the historical background.

On the other hand, papers providing reliable information on the composition of bezoars are less numerous and it has been noticed, moreover, that very little is known about many bezoars now preserved in museums and art-galleries. It is the scope of the present contribution to publish the results obtained on a great number of samples (more than 200 specimens) available in many places in Europe[1]).

The composition of bezoars became better known as soon as reliable chemical methods were developed. L. J. PROUST (1789) was presumably the first author to provide analytical information on a bezoar, from Peru. The knowledge of the chemical components of animal calculi grew rapidly during the last decade of the XVIIIth century and the first quarter of the XIXth century. Calcium phosphate was first recognized by L. J. PROUST (1789), magnesium phosphates (for instance the triple salt: magnesium ammonium phosphate hydrate) and calcium carbonate by A. F. FOURCROY (1793), calcium oxalate by A. F. FOURCROY and L. N. VAUQUELIN (1804), uric acid by J. F. JOHN (1816) and cholesterol by J. L. LASSAIGNE (1826). Further, lithofellic acid by F. GÖBEL (1841) and ellagic acid and potassium urate by T. TAYLOR (1845-6). Important contributions, with respect to the number of bezoars considered, have been made by A. F. FOURCROY and L. N. VAUQUELIN (1804), J. F. JOHN (1816), N. J. B. GUIBOURT (1843-51), T. TAYLOR (1845) and H. LUDWIG (1856).

At first, data on bezoars were published in journals in the field of chemistry and pharmacy, but with the development of science, data were also to be looked for in mammalogical and veterinary journals and in handbooks on animal pathology.

Physical methods (polarizing microscope, X-ray diffraction) allowed further specification of the components, known by their mineral names: brushite $CaHPO_4.2H_2O$, whitlockite $Ca_3(PO_4)_2$ and apatite for the calcium phosphates; calcite, aragonite and vaterite for the calcium carbonates; struvite $MgNH_4PO_4.6H_2O$, newberyite $MgHPO_4.3H_2O$ and bobierite $Mg_3(PO_4)_2.8H_2O$ for the magnesium phosphates; whewellite $CaOx.H_2O$

and weddellite $CaOx.2H_2O$ for the calcium oxalates. With F. A. BANNISTER, M. H. HEY and K. P. OAKLEY (1947) and with C. MILTON and J. AXELROD (1951) the first X-ray diffraction data became available for animal calculi, permitting precise identification of the crystalline constituents. Cystine, xanthine, bilirubin, calcium bilirubin and some urates also joined the series of components of animal calculi.

Described material is, of course, very valuable for historical and scientific comparison purposes. In this respect it is deplored that no one lithofellic acid bezoar, described before 1966, could be traced. In spite of the best goodwill of so many curators[2]), the earlier described lithofellic acid bezoars are to be considered as lost owing to repeated removals or as destroyed by war action.

Such an unfortunate fate suffered the important collection of animal calculi, so carefully described by T. TAYLOR (1845) of the Royal College of Surgeons in London, which was destroyed by bombing in 1941, and the large stone, described by MALAGUTI (1842) and said to be kept at the "Musées de Rennes", presumably destroyed by war action in 1944.

It is also unfortunate that the numerous (more than fourty) bezoars from the "Cabinet du Roi", described by J. L. DE BUFFON and L. J. M. DAUBENTON (1764), could not be traced[3]). Search for a famous bezoar (56 ounces) from Peru, given to Pope Gregory XIII in 1534[4]), and for bezoars which once belonged to Queen Elisabeth I[5]) also remained unsuccessful.

II. MATERIAL EXAMINED

For the purpose of the present contribution, material became available from nearly twenty collections in Europe, whose inventorization is given in Table I. Wellstocked collections of bezoars were found in:

a) the "*Rijksmuseum voor de Geschiedenis der Natuurwetenschappen*", *Leiden*, with its "Simpliciakast (kruidenkast) Collegium Pharmaceuticum (= Apothekersgilde), Den Haag", reg. no. Ph 4; "Kast met obseleta omstreeks 1800", reg. no. Ph 5; "Kistje met 4 occ. en 4 or. bezoarstenen. Pharmaceutisch Laboratorium, Utrecht", reg. no. Ph 37; "Bezoar Simiae in glazen stopfles", reg. no. Ph 38; "Simpliciakast Dr. H. de Bosch (1720-1777)", reg. no. Ph 146; "Lapis de Goa in flesje", reg. no. Ph 39, and "Type Varkensgalsteen", purchase 1966, reg. no. 186.

b) the "*Geschiedkundig Medisch Farmaceutisch Museum*", *Amsterdam*,

with its "Simpliciakast met catalogus 1824" (14 bezoars) and "Collectie van het Kon. Oudheidkundig Genootschap van Amsterdam, nr. 1904" (17 bezoars). The catalogue from 1824 mentions among others: "Lapis Bezoar oriental. Antilope Orsy" and "Lapis Bezoar occident. Camelus lama et Vicunna".

c) the "*Dr. H. Van Heurck Museum*", *Antwerp*[6]), with its drugs collection (bezoars nos. 2289 to 2292) presumably assembled before 1865.

d) "*The Wellcome Institute for the History of Medicine*", *London*, with its "de Jussieu Collection, Professeur au Jardin des Plantes, Paris", reg. no. 25: 1973/1 to 28 and A to R.

e) the "*Wissenschaftliche Sammlung des Instituts für Pharmakologie and Toxikologie der Universität Rostock*". Thirty-three bezoars have already been examined with transmitted X-rays by A. BURCHARD (1914) and one Gao stone has been analysed at R. KOBERT's request (1919).

f) the "*Kunsthistorisches Museum, Sammlung für Plastik und Kunstgewerbe*", *Vienna*, with its marvellously ornamented bezoars from the imperial treasuries.

A classification of bezoars reported after R. KOBERT (1919) is as follows:

1. Mineral bezoars
   a. natural concretions
   b. Goa stones
2. Animal bezoars
   a. oriental bezoars (organic composition)
      i) ellagic acid
      ii) lithofellic acid
   b. occidental bezoars (inorganic composition: calcium, magnesium ammonium phosphates)
   c. monkey stones
   d. German bezoars
      i) trichobezoars containing hair
      ii) phytobezoars containing vegetable debris
      iii) intestinal mineral precipitates
3. Human calculi and stones (gastrolites, enterolites, coprolites, etc.)

There appears to be no room in this classification for the pig stones ("pedro del porco", "opregte varkenssteen" according to G. E. RUMPHIUS, 1705, "lapis malaccensis", bezoars from porcupines, hedge-hog stones). They should best be classified along with the bezoars of organic composition.

III. Composition

Table I refers to more than 200 bezoars examined. Their identification is mainly based on X-ray diffraction data and, occasionally, on chemical, optical and other physical tests. It should be borne in mind that, in many cases, sampling has been performed only on the outside layers, in order not to damage the specimen. So doing, no observation is available for the interior. Although calculi are known with complex composition (layer of brushite around newberyite, C. Milton and J. Axelrod, 1951; gallstones of bilirubin with cholesterol nucleus; calcium phosphate — calcium oxalates bezoar (no. 3259) from the "Kunsthistorisches Museum", Vienna), chemically "homogeneous" calculi (homogeneous besides the nucleus) seem prevailing.

According to the results obtained (Table I), the different kinds of the bezoars examined can be listed as follows, with respect to their chemical and mineralogical composition:

1. Magnesium phosphate bezoars: struvite, newberyite[7]) and bobierrite
2. Calcium phosphate bezoars: brushite, whitlockite, apatite
3. Calcium carbonate bezoars: calcite, aragonite
4. Calcium oxalate bezoars: whewellite, weddellite
5. Ellagic acid bezoars
6. Lithofellic acid bezoars
7. Uric acid bezoars
8. Yellowish-brownish resinous bezoars (organic composition A)[8])
9. Pigmented gallstones (organic composition B)[9])
10. Cholesterol bezoars
11. Tricho- and phytobezoars
12. Mineral bezoars: calcite, iron oxide[10])
13. Man-made products: Goa stones[11]), gypsum, etc.

From Table I it can be seen that ellagic acid and calcium phosphate bezoars prevail in the specimens examined and that lithofellic acid bezoars are rather scanty. For comparison it may be mentioned that T. Taylor (1845) listed 24 ellagic acid bezoars next to 19 lithofellic acid ones, and H. Ludwig (1856) 5 next to 2.

Table I. Inventory of the bezoars examined

LOCALITY Collection	Number of bezoars	Magnesium phosphates	Calcium phosphates	Calcium carbonates	Calcium oxalates	Ellagic acid	Lithofellic acid	Uric acid	Organic composition A	Pigmented bezoars B	Cholesterol	Tricho- & phytobezoars	Iron oxide	Artifacts
AMSTERDAM														
Rijksmuseum	1	—	—	—	—	—	—	—	1	—	—	—	—	—
Gesch. Med. Farm. Mus.	31	—	11	—	—	12	2	—	—	—	—	—	—	6
Mus. Tropen	4	—	—	—	—	4	—	—	—	—	—	—	—	—
Scheepvaart Mus.	1	—	—	—	—	—	—	—	1	—	—	—	—	—
Priv. Coll. Wittop Koning	2	—	—	—	—	1	—	—	—	—	—	—	—	1
ANTWERP														
Van Heurck's Mus.	52 (1)	—	35	3	—	7	—	—	—	—	—	—	—	7
BRUSSSELS														
Inst. roy. Sci. nat.	8(2)	—	2	—	—	—	6	—	—	—	—	—	—	—
COPENHAGUE														
Nationalmuseet	1	—	—	—	—	—	—	—	—	—	—	—	—	1
GOUDA														
Priv. Coll. Grendel	2	—	—	—	—	1	—	—	—	—	—	—	—	1
LEIDEN														
Rijksmus. Gesch. Natuurw.	47	—	24	2	—	15	1	1	2	—	—	—	—	2
LONDON														
Brit. Mus.	2	—	—	—	—	—	—	—	—	—	—	—	—	2(3)
Brit. Mus. (N.H.)	5	—	2(4)	—	—	2(4, 5)	1	—	—	—	—	—	—	—
Wellcome Inst.	37	4	15	2	1	9	1	2	—	1	1	1	—	—
MUNICH														
Residence's Treasury	6	1	2	—	1	1	—	—	—	—	—	—	—	1
PARIS														
Fac. Pharm. Univ.	1	—	—	—	—	—	—	—	—	—	—	—	1(6)	—
ROSTOCK														
Inst. Pharm. Univ.	16	1	1	—	—	6	—	—	—	—	—	4	1	3
VIENNA														
Kunsthist. Mus.	12	4	6	—	1	1	—	—	—	—	—	—	—	—
Treasury O.T.	3(7)	—	—	—	1	2	—	—	—	—	—	—	—	—

(1) Cf. R. VAN TASSEL (1970)
(2) Cf. S. FRECHKOP & R. VAN TASSEL (1966), R. VAN TASSEL (1972)
(3) Information communicated by W. ZWALF (1972)
(4) Cf. J. M. SWEET (1935)
(5) Identification D. J. SUTOR, London.
(6) Identification J. FLAHAUT, Paris (1970)
(7) Sampling kindly performed by A. PREISINGER, Vienna (1972)

IV. Bezoars and accompanying old documentation

In order to check which kind of bezoar is covered by the accompanying old labels or catalogue inscriptions, following inventorization can be made based on the specimens examined:

"*Oriental bezoars*" (26 specimens). Among them 21 are ellagic acid, 2 lithofellic acid, 1 calcium phosphate (brushite), 1 calcite and 1 goethite.

"*Echter Bezoar*" (1 specimen). This Rostock's bezoar is ellagic acid.

"*Bezoard soupsonné de faux*" (1 specimen). This specimen no. J from the Wellcome Inst. is ellagic acid. The label further specifies: "il vient d'holande".

"*Occidental bezoars*" (20 specimens). Among them, 17 are calcium phosphate (brushite and/or whitlockite), 1 calcite, 1 calcium oxalate (whewellite) and 1 uric acid.

"*Bezoar germanic.*" (7 specimens). Among them, 3 are trichobezoars (Rostock's collection) and 4 calcium phosphate (Gesch. Med. Farma. Mus., Amsterdam).

"*Lapis bezoardicus fossilis*" (1 specimen). This bezoar (no. 34, Ph 146, Leiden), also labelled "gegraave bezoarsteen" is brushite.

"*Goa stones*" (19 specimens). These stones are artificial and complex in composition. They are mostly covered with or show traces of gold foil. They are mainly of light colour, porous, devoid of concentric layers, but may show internal shrinkage cracks.

Some labels give more detailed information:

a) referring to geographical origin.

"*Bezouard de Perse*" (1 specimen, no. F, Wellcome Inst.) is calcium phosphate (whitlockite).

"*Bezoard de Quito*" (1 specimen, no. 6, Wellcome Inst.) is calcium phosphate (brushite).

"*Bezoard du Pérou*" (2 specimens, no. I, Wellcome Inst.) is calcium phosphate (whitlockite).

"*Bezoar Porci*" (1 specimen, Rostock) is magnesium phosphate (struvite and newberyite). According to A. Burchard (1914), who examined the Rostock's bezoars in X-ray transmission, "Bezoar Porci" presumably refers to the Peruvian locality Porco.

"*Bezoar du Mexique*" (6 specimens, Brussels) is lithofellic acid.

"*Bezouars ... mont Argées en Capadoce*" (1 specimen, no. G, Wellcome Inst.) is presumably bilirubin and its derivates.

b) referring to animals or human beings.

"*Bezoar cabris*" (1 specimen, no. A, Wellcome Inst.) is lithofellic acid[12]).

"*Bezouars ... fiel ... beuf ...*" (1 specimen, no. G, Wellcome Inst.): presumably bilirubin derivates[13]).

"*Bezoars ... ventricule ... chien maron ou cabry ...*" (many small spheres, no. K, Wellcome Inst.): calcite.

"*Magenstein eines Kamels*" (1 specimen, no. 980, Kunsthist. Mus., Vienna). This large spherical stone, 1090 g, is a magnesium phosphate (struvite).

"*Pedro del Porco*" (5 specimens). One "Pierre de porc" (no. C, Wellcome Inst.) is a phytobezoar, one "Pedro del Porco" (no. OG 2, Gesch. Med. Farm. Mus., Amsterdam) is ellagic acid, and three specimens ("Pedro del Porco" from the Rijksmuseum and the Scheepvaart Museum, Amsterdam, and a "Type Varkensgalsteen" from Leiden) are of unknown organic composition (composition A in Table I)[14]).

Monkey stones (2 specimens). One "Bezoar Simiae" (no. 47, Ph 38, Leiden) is brushite, one "Bézoar de singe" (no. H, Wellcome Inst.) is ellagic acid.

"*Bezoard de la Danta*" (3 specimens, no. B, Wellcome Inst.). The three rounded pyramidal stones are magnesium phosphate (newberyite). "Danta" is the name given to a tapir by natives of South America (G. F. KUNZ, 1915, p. 214)[15]).

"*Een Steentje dat in de ... van een bul gevonden is, 1704*" (no. L, Wellcome Inst.) is calcite.

"*Bezoard ... vésicule du fiel d'une dame*" (1 specimen, no. E, Wellcome Inst.) is cholesterol[16]).

"*Pierres trouvées dans la vessie d'un curé*" (5 specimens, no. M, Wellcome Inst.) are uric acid.

c) referring to particular information.

"*Bezoard provenant du droguier de Monsieur de Baumé*" (1 specimen, Paris) is goethite. (Identification due to J. FLAHAUT at G. DILLEMANN's request).

According to G. DILLEMANN (priv. comm. 1971) this bezoar measures 2 x 3 cm, is brown in colour and kidney-like, has a "polished" surface and shows a silver setting of two narrow bands and a ring, the whole object weighing ± 30 g. The stone contains a loose nucleus and is merely an aetite.

Some difficulty is relevant in locating this bezoar in earlier descriptions.

Indeed, in 1846 G. G. (? GUIBOURT) wrote: "M. Menier a montré un bézoard oriental qui avait appartenu à Baumé et dont il a fait le don le même jour à l'Ecole de Pharmacie. Ce bézoard est ovale, un peu réniforme, du poids de 29.9 grammes, à surface très-polie et brillante, d'un brun foncé et un peu verdâtre à l'extérieur, mais d'une fauve rougeâtre à l'intérieur." The same author considered this bezoar as a "Bézoard fauve", an ellagic acid bezoar. In fact, N. J. B. GUIBOURT, in 1851, classified (p. 97) this bezoar along with the "bézoard fauve ou bézoard ellagique". No mention is made of a silver setting.

On the other hand, N. J. B. GUIBOURT described in 1851 (p. 96), under the heading "Bezoard fauve ou Bezoard ellagique", several stones, among which "un ovoide-allongé, d'un fauve clair et de la grosseur d'une petite noix, renfermé dans deux cercles d'argent, surmontés d'anneau...". Here the names of Menier and Baumé are not mentioned. This description suits for the bezoar examined at present, but the iron composition observed (goethite according to J. FLAHAUT) is, of course, incompatible with an organic composition.

As far as the old labels or old catalogue records really refer to the now accompanying samples, it is to be noted that similar names cover quite different kinds of bezoars. Confusion must have been increased, when seeing that some authors (T. TAYLOR, 1845, for instance) have considered ellagic acid acids bezoars as oriental and lithofellic acid bezoars as occidental, while many others (N. J. B. GUIBOURT, 1851, for instance) have classified lithofellic acid bezoars as oriental. Nevertheless it appears, from the specimens examined, that "oriental bezoars" are chiefly ellagic acid bezoars and "occidental bezoars" calcium phosphate bezoars. Anyhow, one should be very careful when drawing conclusions from old labels with respect to the composition.

V. BEZOARS AND RECENT DOCUMENTATION

Recent bezoars are of particular interest because they provide more information and present more garantee with respect to the origin of the stones. Following six *ellagic acid bezoars* can be listed here:

One specimen from a wild goat, Shiraz, Persia (Wellcome Inst., no. A 199302)[17]).

One specimen from a leaf-eating monkey (Presbytis), somewhere in Borneo (British Mus. Nat. Hist., no. 1966-301)[18]).

Four specimens from Borneo (among them three more particularly from Apo Kajan) (Mus. Tropen, Amsterdam, nos. 1322/172 a + b, 391-181, 391-182, 391-183).

From this, it is obvious that ellagic acid occurs not only in bezoars from goats in Persia, but also from monkeys in Borneo, a statement which has already been made.

The characteristics of these ellagic acid bezoars are summarized as follows:

Wellcome Inst., no. A 199302: complete bean-like form, 0.9 x 0.9 x 2.5 cm, 2.5 g, spec. grav. 1.60.

B.M. (N.H.), no. 1966-301: oval form, 2.2 x 2.6 x 3.4 cm, 16.4 g, spec. grav. 1.66[18]).

Pure ellagic acid has spec. grav. 1.66.

Museum Tropics, Amsterdam[19]):

no. 1322/172a: ovalround form, 1.7 x 1.8 x 2.1 cm, 4.1 g.

no. 1322/172b: broken, elongated ovoid form, 1.5 x 1.8 x 2.2 cm, 2.3 g.

no. 391-181: ellipsoid form, 2.8 x 3 x 3.5 cm, 25 g.

no. 391-182: ovoid form, 2.5 x 2.7 x 3.3 cm, 17.5 g.

no. 391-183: flattened ellipsoid form, 1.9 x 2.9 x 3.2 cm, 17 g.

VI. Size of bezoars

The size of the stones examined is quite variable and ranges from a few mm to more than a decimeter across. Data for various kinds of bezoar are summarized as follows:

Magnesium phosphates bezoars.

They reach considerable dimensions. Good examples are the spherical bezoars from the "Kunsthistorisches Museum", Vienna, no. 980, 1090 g, 10.5 cm in diameter, and no. 994, 12.5 cm in diameter, and from the "Schatzkammer Residenz München", no. 558, 10 cm in diameter. These dimensions are not exceptional, as spherical calculi from horses have been recorded with a diameter of 15 cm or a weight of 10 kg.

Calcium phosphates bezoars.

They are usually of a smaller size. Their form can be irregular, although ovoids prevail. Large specimens are noticed from the "Kunsthistorisches Museum", Vienna, no. 998, 16 cm long, and from the "Schatzkammer", Munich, nos. 554 and 555, with 5 x 7 cm and 6.5 x 10 cm respectively.

Calcium oxalates bezoars

They generally present an elongated form. Large specimens are seen in Vienna ("Kunsthistorisches Museum", no. 1001, and "Schatzkammer D.O., no. 139) and measure respectively 8 and 12.5 cm in length, and in Munich, no. 1107, 10 cm long.

Calcium carbonate bezoars.

Three spheroid specimens (Mus. H. VAN HEURCK, Antwerp) measure 1 to 3 cm across. Two specimens are noticed in Leiden: one spherical, 2 cm across (no. 22, reg. Ph 5), is found among the occidental bezoars; the other, ovoid, 3 x 3 x 4 cm (no. 33, reg. Ph 5), among the oriental bezoars. A small stone from a bull is only 4 mm across (no. L, Wellcome Inst.) and a hundred pearls, with golden lustre, from the ventricle of a "chien maron ou cabry, Pondichéry, 1761" are 1 to 2 mm across (no. K, Wellcome Inst.).

Lithofellic acid bezoars.

The dimensions of the ten bezoars examined vary from 2.5 x 3 cm to 10 x 15.5 cm. The largest specimen, weighing 620 g, appears to be quite exceptional (Brussels). Data found in the literature prior to 1966 only indicate large specimens of 110 g and $\pm$ 200 g.

Ellagic acid bezoars.

Ovoid, cylindrical or nut-shaped bezoars vary from 1 to 6 cm across. One specimens from Munich (no. 556) is 4 x 6 cm and another from Vienna ("Schatzkammer D.O.," no. 138) is 5.5 cm long (30 g).

Pig bezoars

The three spherical resinous bezoars, of unknown organic composition, measure from 2 to 3.5 cm across.

Goa stones

These man-made products are chiefly ovoid and are of a rather constant size of $\pm$ 3 cm across.

VII. ORNAMENTED BEZOARS

The best proof that bezoars were highly priced in past times, is given by the fact that fine goldsmith's and jeweller's work ornaments the rather unpretty looking bezoars. Fine examples are indeed to be seen in the "Kunsthistorisches Museum" and the "Schatzkammer des Deutschen Ordens" in Vienna, in the "Schatzkammer der Residenz München", in the "Rijksmuseum voor de Geschiedenis der Natuurwetenschappen" in Leiden, in the "Rijksmuseum" and the "Scheepvaart Museum" in

Amsterdam, in the "Nationalmuseet" in Copenhague. The ornamented bezoars are enumerated here with some detail[20]).

"*Kunsthistorisches Museum*", *Vienna.*

— Magnesium phosphate (struvite) bezoar (no. 980, fig. Kris 121): sphere 10.5 cm in diameter, 1090 g, on a silver foot, German, from the XVIIth century[21]).

— Magnesium phosphate (struvite) bezoar (no. 981, fig. Kris 28, H &K 289, Cat 64): sphere 11 cm in diameter, with emeralds and gilded bronze, ? Spanish, from the XVIIth century.

— Magnesium phosphate (struvite) bezoar (no. 994, fig. Kris 26 & 27, WB, Cat 64): imperfect sphere, 11 to 12 cm in diameter, with Portuguese golden setting and chain, from 1600-1650.

— Calcium phosphate (brushite, whitlockite) bezoar (no. 67): ovoid form, 4.5 x 6 x 7.5 cm, 190 g.

— Calcium phosphate (brushite) bezoar (no. 958): dumb-bell form, 4.5 x 8.5 cm, with golden ring bearing the inscription: PIEDRA BESOHAR FINISSIMA PESA OCHO ONCAS.

— Calcium phosphate (brushite, whitlockite) bezoar (no. 957, fig. Br, H & K 828): round ovoid form, 5 x 6 x7 cm, with German golden setting from the XVth century.

— Calcium phosphate (brushite, whitlockite) bezoar (no. 998): elongated form, 16 cm, with Spanish gilded silver filigree and chain, from the XVIth century.

— Calcium phosphate (brushite) bezoar (no. 3744): ovoid form, 2 x 2.5 x 4 cm, mounted with gilded silver foot in a drinking vessel of a rhinoceros horn, from the XVIIth century.

— Calcium phosphate — calcium oxalate (brushite, whitlockite, weddellite, bobierite) bezoar (no. 3259, fig. Wittop Koning, 1949 and 1966): hollowed sphere in cup form, 6 x 7.5 x 8 cm, with enamelled ring from the XVIth century. The composition of this bezoar is rather complex. The phosphates seem to be the dominant components. Some hair is also enclosed.

— Calcium oxalate (whewellite, weddellite) bezoar (no. 1001): elongated form, 3.5 x 4.5 x 8 cm, with gold filigree from the XVIIth century.

— Ellagic acid bezoar (no. 1140, fig. Br, Kunz, H & K 279): ovoid form, 2.5 x 3 x 5 cm, with gold filigree from the XVIth century.

"*Schatzkammer des Deutschen Ordens*", *Vienna*[22]).

— Calcium oxalate (weddellite, whewellite) bezoar (no. 139): elongated

form, 12.5 cm, with golden rings from the XVIth century.
— Ellagic acid bezoar (no. 137): bean-like form, 4.3 cm long, with gold filigree from the XVI-XVIIth century.
— Ellagic acid bezoar (no. 138): ovoid, 5.5 cm long, with gold filigree from ± 1600.
The stone weighs 30 g and has a spec. grav. of 1.32 (A. PREISINGER, 1972).
"*Schatzkammer der Residenz München*", *Munich.*
— Magnesium phosphate (newberyite) bezoar (no. 558, fig. H & K 274): irregular sphere, 8 cm in diameter, German gilded silver setting from ± 1650.
— Calcium phosphate (brushite) bezoar (no. 554, fig. H & K 273): ovoid 5.0 x 6.8 cm, with emeralds and German golden setting from 1570-80. Analysis of a minute fragment gave 38% P_2O_5.
— Calcium phosphate (brushite) bezoar (no. 555, fig. H & K 643): ovoid 6,5 x 10,5 cm, with German golden setting from the end of the XVIIth century.
— Calcium oxalate (weddellite) bezoar (no. 1107, fig. H & K 277): ovoid, 10 cm long, with German gilded silver filigree and chain from 1650-1700.
— Ellagic acid bezoar (no. 556, fig. H & K 276): ovoid, 4 x 6 cm, with German gilded silver filigree from 1610-20.
— Man-made product composed mainly of calcite and quartz (no. 557, H & K 278): ovoid, 7 x 10,5 cm, with German gilded silver from ± 1650. The catalogue 1971 (p. 234) mentions: "Der Bezoar wahrscheinlich gefälscht".
"*Rijksmuseum*" *and* "*Nederlandsch Historisch Scheepvaart Museum*", *both in Amsterdam, and* "*Rijksmuseum voor de Geschiedenis der Natuurwetenschappen*", *Leiden.*

These three Dutch museums each own a pig stone: a "Piedro del Porco", 2 cm in diameter ("Rijksmuseum", Amsterdam, no. N.M. 7082), from a "XVIIIe eeuwse Stadhouderlijke verzameling"; a "Petro de Porco" according to a certificate from 1734, 3.5 cm in diameter ("Scheepvaart Museum", Amsterdam, no. A 3873), and a "Type Varkensgalsteen", 2.5 cm in diameter (Leiden, no. Ph 186). The stones are of similar composition of unknown organic substances and are set in gold filigree attached to a golden chain. The specimen of the "Scheepvaart Museum" is kept in an ovoid gilded silver box (4.3 x 4.3 x 5 cm), from the XVIIIth century, which, on its turn, can be put into a green brocatelle bag.

"*Nationalmuseet*", *Copenhague.*

A hollow stone in cup-form "Bezoarpokal", no. D 451, is mounted in a gilded silver setting[23]). The huge ovoid stone, 13.3 x 18 cm (not 44 cm as sometimes reported, this dimension being the height of the whole object of art), with a "$\frac{1}{2}$ cm tyk kalkagtig Masse" according to M. MACKEPRANG, is merely a man-made product. The matrix is chiefly gypsum with some minute inclusions of anhydrite and some grains of calcite and quartz. The analysis of a minute sample, with specific gravity 1.79, gave 19% loss at 100° C and 44% SO_3 in agreement with the composition of gypsum: 21% H_2O and 46.5% SO_3. M. MACKEPRANG (1902) and J. OLRIK (1909), while describing this object of art, have been aware of the questionable nature of the stone, and of the accompanying certificate as well, but the whole ornamented object nevertheless remains a splendid token of the silversmith's artistic skill (figs. M. MACKEPRANG 1902, J. OLRIK 1909, K. A. VAN ANDEL 1928 and D. A. WITTOP KONING 1966).

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3) No trace has been found in the "Muséum d'Histoire naturelle" (Laboratoire de Minéralogie, Institut de Paléontologie, Laboratoire d'Anatomie comparée, Institut de Zoologie des Mammifères) in Paris, nor in the "Musée du Louvre" and in the "Cabinet des Médailles" of the "Bibliothèque nationale". Thanks are due to many correspondents for their kind cooperation.

4) Excerpt from "In Metallothecam Vaticanam Praefatio Joannis Mariae Lancisii", page xv, posthumous publication (1717-1719) of M. MERCATI (1541-1593): "Postquam autem de Metallotheca situ, haec nec quidem pauca deprehendimus; quibus cesserint corpora ipsa metallica, & fossilia divinare non potuimus; suspicari tamen licet (cùm institutum certè opus esset, sed neque dote orantum, neque custode munitum) ab haeredibus, quae Mercati erant, quàm citissimè asportata fuisse". The Librarian of the Vatican informed (priv. comm. 17.3.1971) that one does not know what happened to the MERCATI's collection.

On page 175 of "Metallotheca Vaticana" a description is given of the huge bezoar. G. F. KUNZ (1915) can be quoted here: "Mercati writes of a marvellous Occidental bezoar, sent from Peru to Rome in 1534, as a gift to Pope Gregory XIII. It weighed no less than fifty-six ounces, although it was defective, since a large portion of the exterior crust was missing, the second layer was partly broken away, and even the third layer was damaged in some places. This wonderful concretion had been dedicated to one of the Peruvian gods, as a rare and precious object, and it was taken away by the Spaniards when they spoiled the temple. Mercato says that 'this bezoar was of a truly monstrous size, unheard of in all previous centuries, and it is still the largest in the whole realm of nature'."

5) From the "Warrant of Indemnity for the Delivery of Jewels to King James the First" (R. LEMON, 1827) following details are quoted: "... one great Bezar stone, sett in gould, which was Queene Elisabeth's ... and one other large Bezar stone, broken in peeces, delivered to our owne handes, by the Lord Broke, the two and twentith day of Januarie, one thousand sixe hundred twenty and two" (p. 153). Major General W. D. M. RAEBURN, H. M. Tower of London, informed (priv. comm. 11.5.1972) that there are no bezoars in the present Crown Jewels and he added that doubtless those in the possession of James I were sold in the Commonwealth period with the greater part of the Regalia to pay the Army.

6) E. FRISON, "Henri Ferdinand Van Heurck (1838-1909). Sa vie, son oeuvre." Comm. Rijksmus. Gesch. Natuurw., Leiden, III, 106 pp., 1959.

7) Newberyite is to be considered as an alteration product of struvite. Fresh crystalline looking struvite surfaces turn, at length, to a white powder, along with the formation of newberyite.

8) Unknown composition, observed for four spherical bezoars, 2 to 3.5 cm in diameter. Chemical analysis of a specimen from Leiden (no. 44, reg. Ph 4) gave: 57.80% C, 8.70 H, 20,38 O, 5.47 S, 4.65 N. M. H. KLAPROTH (1816) made some chemical tests on a "von Malakkischem Stechelschweine kommender Bezoar", set in gold filigree, from the famous SEBA's collection. It is uncertain whether this bezoar is similar to the bezoars here considered.

9) A single pigmented ovoid bezoar, rusty brown, about 1 cm across (Wellcome Inst., no. G), presumably contains bilirubin and calcium bilirubin.

10) The iron concretions commonly have a loose nucleus and are then to be classified among the aetites or "Adlersteine".

11) The composition of the Goa stones is complex and shows, among others, clay, quartz, calcium carbonate (effervescence with acid!). R. KOBERT (1919) mentioned clay ("Tonerdesilikat" for the composition of a Rostock's Goa stone and H. LUDWIG (1856) mentioned clay, talc, calcium phosphate and iron oxide in the residue after ignition developing a smell of balsam.

12) The label, as far as it can be read, indicates: "Bezoar decabris éprouvé par une personne mordue de chien enragé ... de la poudre donné à boire".

13) The label indicates: "Bezouars qui se trouve dans le fiel des beuf qui pesse sur le mont Argées en Capadoce".

14) This kind of bezoar is most likely to assimilate with the "opregte varkenssteen" of G. E. RUMPHIUS (1705).

15) The specimens were wrapped in a sheet of paper, bearing the name "Jos. Dejussieu". Joseph de Jussieu (1704-1779) stayed more than half his life in South America.

16) The specimen was wrapped in a sheet of paper adressed to "Monsieur Bernard De Jussieu". Bernard de Jussieu (1699-1777) was "Démonstrateur au Jardin du Roi", Paris.

17) Specimen kindly communicated by C. A. SIZER, Curator, in 1970. The specimen is mentioned by D. HOOPER (1937, p. 137) in "Useful Plants and Drugs in Iran and Iraq", Field Mus. Nat. Hist., Bot. Ser., 9, no. 3, 1937, Publ. 387, Chicago.

18) Purchase Dr. Tom HARRISON, Sarawak. "Polished" specimen, oval form, grey-greenish brown. (Informations kindly communicated by G. F. CLARINGBULL, Director B.M. (N.H.), 1972; identification by J. L. SUTOR, London.)

19) Data kindly provided by A. M. P. A. FLUYTER, Amsterdam, in 1970. No. 172 is a loan in 1939 and nos. 181, 182 and 183 are a purchase H. A. H. H. PIMENTEL in 1927.

20) The register numbers are given and fine arts information is quoted according to

the Catalogues 1964 ("Kunsthistorisches Museum") and 1971 ("Schatzkammer D.O.") for Vienna, the Catalogue 1970 ("Schatzkammer Residenz") for Munich and the book of L. HANSMANN and L. KRISS-RETTENBECK (1966). Reference is made to authors who have figured the specimen: Br stands for Brassler (1913), H & K for HANSMANN and KRISS-RETTENBECK, Cat for Catalogue, 1964, 1970 or 1971.

21) The Register of the Museum mentions: "Dreifüssiges Gestell von Silber ... auf demselben ein Magenstein eines Kamels. XVII Jahrh.". E. KRIS (1932) wrote: "Aus der Schatzkammer (Inv. 1750, f. 514: "Ein grosses Stuck gediehenes Silbergewächs auf einem von Silber ausgearbeiteten Fuss, ..."). Der Stein in späteren Inventaren irrtümlich als Bezoar beschrieben."

22) Thanks are due to the "Abthochmeister O.T.", to H. FILLITZ, and to A. PREISINGER for sampling.

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Kon. Belgisch Instituut
voor Natuurwetenschappen,
Brussels

R. VAN TASSEL